

labiosa. *Palæmon varians* and *Philhydrus maritimus*, Solier, are very abundant. Near the bank freshwater plants, *Scirpi* and rushes, are very vigorous, and accommodate themselves very well to an existence in the brackish water.

The pool situated to the west of the Grand Havre is less extensive than the preceding; the sea-water penetrates into it by infiltration. I have found numerous larvæ of Diptera belonging to at least four different species, as well as the larvæ of a Hemipteron belonging to the genus *Corixa*, associated with *Philhydrus*. *Melita palmata* and *Jera Nordmanni* are very abundant, as well as *Gammari*. In the mud which occurs near the margins I have found several specimens of *Nereis falsa*, Quatref.

[To be continued.]

XXX.—*Notes from the St. Andrews Marine Laboratory (under the Fishery Board for Scotland).*—No. VI. *On the very young Cod and other Food-Fishes.* By Prof. M'INTOSH, M.D., LL.D., F.R.S., &c.*

It is about twenty years (viz. 20th May, 1866) since Prof. G. O. Sars found the larval cod 6–7 millim.† in length on the surface of a sea teeming with ova off Loffoden; yet up to this time there is no account of a connected series between the larval fish as it issues from the ovum and the larger forms mentioned by Sars and other authors. It is true Sars gives various links in the chain:—Thus, on the 12th June, 1866, he again observed the young cod at the surface, the largest reaching 24 millim. in length, and he considers they had attained this size in the interval (three weeks). Their embryonic fin-fold has now become divided into first and second dorsals, and a small barbel is present. On the 5th July he procured others an inch and a half in length under Medusæ. His observations were continued in the following year, for on the 3rd August he met with young cod two inches and upwards, and on the 23rd of the same month nearly three inches in length. In the beginning of October again they were upwards of four

* Communicated by the Author, having been read at the Birmingham Meeting of the British Association (Biological Section), Sept. 1886.

† This is larger than recently-hatched cod in this country.

inches long. In November of the following year he caught some about six inches long, and larger forms in December. In the early part of the next year (probably the end of February) the young cod had reached a foot in length. He therefore concluded that he had a fairly connected series under review, and accordingly summarizes as follows:—When the young cod are hatched in April and May the yolk-sac keeps them floating on the surface of the water, tossed about by wind and waves. After absorption of the yolk-sac they begin to lead a more independent life, though not strong enough to resist the currents. Towards the end of summer they are about an inch in length and come nearer the shore, in company with *Medusæ* or in the lines of floating sea-weeds. They, as a rule, keep near the bottom. Those seen towards the end of February about a foot in length are thus a year old. Finally, as they get older they go out to sea.

It is remarkable that no zoologist has repeated these interesting and valuable observations. The obstacles are, however, considerable, the chief being the difficulty of finding the fishes on the same or neighbouring ground at the various stages, or proving the continuity in age of the respective groups on different grounds; and, secondly, the absence of due appliances in ships and boats in this country. However, thanks mainly to the enlightened exertions of Lord Dalhousie, we shall by-and-by be in a position to afford further information on this and other food-fishes.

In the trawling experiments of 1884 the young cod were found in vast numbers near the surface of the sea on the great banks frequented by the adult fishes, such as Smith Bank, off the coast of Caithness, and the rich ground south-east of the Island of May. These little cod (a few millim. in length) are easily recognized by the peculiar arrangement of the black pigment-specks*; indeed there is no larval fish known to me which at present can be confounded with them. This statement, however, is not of much moment, since it must be stated that no larval fish with which we are at present acquainted can be confounded with another, so definite are the characters of the pigment and other parts after a brief period of freedom. On the east coast of Scotland the young cod escape from the ova during the month of April, sometimes a little earlier, sometimes a little later, according to the nature of the winter. In the laboratory they could seldom be kept

* These are well seen when the fishes are placed in sea-water in a white porcelain vessel, and they have been carefully drawn by Mr. E. E. Prince.

alive longer than a month, when they attained the length of about 5 or 6 millim., though it is probable growth is somewhat slower in confinement than in freedom. It is clear at any rate that a fish which is hatched devoid of a mouth and circulation in April, and only a few millim. in length, cannot (so far as present observations lend support) grow to any considerable size or attain great complexity of organization that season.

At sea the forms a little older than those seen in the laboratory have generally escaped us, only a specimen or two half an inch long having been captured in the tow-net; yet certain parts of the sea in May and June must abound with the early stages of the cod. Of the later stages in every variety there is no lack. Early in June, or, in some years, in July, young cod appear off the rocks at St. Andrews in shoals, their length varying from $1\frac{1}{8}$ in. to $1\frac{3}{4}$ in. A month later they have attained $1\frac{3}{8}$ to $2\frac{1}{2}$ in. They accompany the green cod into the rock-pools, rich in tangles and other seaweeds, and which have a communication with the sea. They feed there on the multitudes of larval crustaceans and Copepoda, and shelter themselves under the blades of the seaweeds when hunted. They are easily recognized by the reddish colour of the occiput and gills; and their coloration (diced), large heads, lean bodies, and slower motion distinguish them from their associates, the young green cod, many of which show a very distinct barbel on the chin, though it is small in the adult. They go on growing as Sars indicates and as mentioned in the 'Trawling Report.'

To be brief, the main point of this note is the age of these young cod which appear off St. Andrews rocks in June and July. The spawning-season on the east coast of Scotland (as ascertained both by examination and dissection of the adults and capture of the eggs and embryos) is tolerably uniform, and thus a fixed date is given for the reckoning. According to Prof. Sars these would appear to be the young of the season, and which next February would be a foot in length. So far, however, as the growth of other fishes can afford a means for comparison and judgment, it seems doubtful if so rapid a growth can take place between April and June. The condition of the vertebral column, skeleton in general, and the structure of the otoliths (*sagitta* and *asteriscus*) in the smallest of those which appeared this year on the 7th June seem to me to point to their being the young of the previous season, if the observations on the spawning-period are correct, and indeed this would require to be much antedated to fall in with the condition of the young cod as

observed in June. That a tiny embryo (a few millim. in length) in April should in June and July have reached so large a size, and with organs so complex, seems at variance with what is known of the growth of other Teleosteans—for example, of the salmon, catfish, ling, gurnard, skulpin, and the Pleuronectidæ. Even the catfish, which in its adult state is nearly the size of the cod, and which deposits its large ova (of the size of a salmon's) at the end of the year, does not attain such proportions at this period (June) in confinement, and though feeding freely. Mr. R. E. Earll also observes * that in America the young cod $1\frac{1}{2}$ to 3 inches in length in June had been spawned the previous December. Couch mentions his meeting with young cod less (that is a little less) than an inch in May, a size which could hardly apply to those hatched in March or April. Whether the cod spawns earlier in certain regions has not been clearly determined, and, at any rate, the present remarks apply to the east coast of Scotland. Further, the spawning-period this year on the east coast was late, yet the young cod of the size above mentioned appeared in the Laminarian region and rock-pools earlier than last year.

Moreover, the results of the use of the large triangular tow-net † in deep water on board the fishery tender 'Garland' within the last few days corroborate the foregoing view. Quite a new field has been opened up by the use of this net in the foregoing ship and in the yawl 'Dalhousie,' attached to the laboratory, in the shallower water of St. Andrews Bay—a field, indeed, which presents us with novelties of no ordinary interest in regard to the remarkable condition of some of the larval organs, *e.g.* the fins, an instance of which is seen in the very long ochre-coloured ventrals of the young ling ‡. Again, a complete series of young gurnards from the egg up to the adult form has been obtained—the majority of the smaller forms by a single sweep of the net off the island of May; and no young fish is more beautiful as well as more remarkable than a young gurnard about $\frac{3}{4}$ inch in length, for its enormous pectorals are edged with white and finely

* U. S. Fish Com. Rep. 1878.

† This net is made of fine though strong gauze, is fully 20 feet in length, and is fixed to a triangle composed of three wooden beams, each 10 feet long. The latter are hinged so that they can be folded together in transit. The apparatus is sunk to the required depth by a heavy leaden sinker, and kept uniformly there by means of a line and a galvanized iron float, such as is used for the ends of herring-nets. The most active young fishes do not readily escape this net as they do an ordinary tow-net.

‡ This may be (somewhat fancifully) termed the Pterichthyid stage of such fishes.

banded with crescents of pigment (as in the *Trigla lineata* of authors), which likewise forms striking touches here and there on its body. The three free filaments of the pectorals are united by a membrane nearly to the tip, and are used by the fish when creeping on the bottom. The condition of the very young haddock, skulpin, frogfish, ling, rockling, and young flatfishes of various kinds in August (and of this season), all bear out the opinion above expressed, viz. that the young cod which appear off our rocks (and ranging in length from $1\frac{1}{8}$ to $1\frac{3}{4}$ inch in the beginning of June) are not the product of the eggs which abound near the surface of the sea chiefly in April.

In reference to Prof. Sars's remark about the association of the young fishes with Medusæ, I may observe that this association in the earlier stages with the Ctenophora is followed by different results, for occasionally, on examining the contents of the large midwater-net, many *Pleurobranchiæ* have young fishes in their stomachs. These young fishes, it is true, are either dead or sickly; but *Pleurobranchia* is capable of engulfing somewhat active forms, such as Zoecæ. Whether the products of the reproductive organs of the Medusæ are utilized by the larval fishes is still an open question. Their enormous numbers in the sea around them, at all events, is a striking feature. Hydroids, such as *Obelia geniculata*, are greedily eaten by young green cod, and the stomachs of the adult common cod contain diverse Cœlenterates.

XXXI.—*Histological Investigations upon the Nervous System of the Chaetopoda.* By Dr. EMIL ROHDE*.

HISTOLOGICAL investigations upon the nervous system of *Polynoë elegans* had shown me that the so-called neural canals in the Polychæta were colossal nerve-fibres, the detailed study of which promised important data as to the structure of the nervous system in animals generally. By the munificence of the Berlin Academy of Sciences I was last year enabled to work for several months in the Zoological Station at Naples, and to collect from the Polychæta occurring in the Bay abundant materials for the further prosecution of this

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